ACE

PROJECT HIGHLIGHTS

Announcement of Opportunity	AO-95-055-02
NASA Headquarters Office	Space Science (Code 5)
Enterprise	Space Science
Project	Advanced Composition Explorer
Project Lead Center	GSFC
Management Approach	Out-of-House
Mission Life (months)	24 (60 extended)
Additional Data Analysis (months)	0
Launch Date	25 Aug 1997

MISSION OBJECTIVES

The objective of the Advanced Composition Explorer (ACE) is to collect observations of particles of solar, interplanetary, interstellar and galactic origins, spanning the energy range from that of the solar wind (nucleon). Definitive studies will be made of the abundances of essentially all isotopes from H to Zn , with exploratory isotope studies extending to Zr.

FOREIGN PARTICIPATION

Switzerland: The Solar Wind Ion Mass Spectrometer instrument (SWIMS) in collaboration with the University of Maryland.

Germany: Combined Data Processing Unit (DPU) for SWIMS, SWICS, and SEPICA.

SPACECRAFT DESCRIPTION

The ACE spacecraft, Data Point 49, is an octagonal prism with a 160 cm dia. main body. The power system includes four 86 x 152 cm deployed solar panels, providing 500 watts, and a 12 ampere-hour NiCd battery. Two of the panels carry magnetometer booms. The 5rpm spin-stabilized, earth-pointing spin axis is maintained by the Attitude Determination and Control System (ADCS) using a solid-state star tracker and digital sun sensors, in conjunction with a hydrazine propulsion system. In the 48-hour total capacity 1.2 Gigabite solid-state recorders, data is stored for 24 hours at 7 kilobits per second, interleaved with realtime data. The stored data is returned to the Deep Space Network via a 66 cm parabolic antenna for periods up to 4 hours daily, at a rate of 77 kilobits per second. The real time SW data.

PAYLOAD DESCRIPTION

The Advanced Composition Explorer (ACE) payload includes six high resolution particle spectrometers designed to provide the optimum charge, mass, or charge-state resolution in its particular energy range. Each spectrometer has a geometry factor which is optimized for the expected flux levels, in order to provide a collecting power greater by a factor of 10 to 1000 times than that of previous or planned experiments. The payload includes three instruments of standard design to monitor energetic electrons, and H and He ions, and a magnetometer. The ACE spacecraft design is based on the Charge Composition Explorer, built at JHU/APL for the Active Magnetospheric Particle Trace Explorer (AMPTE) Program. The ACE spacecraft occupies a halo orbit about the L1 Earth-Sun libration point, with its spin axis pointed towards the Sun to within +/-20 degrees. Powered by solar cells, the spacecraft has a design life of at least five years, and returns data in daily tape recorder dumps, collected at the NASA-GSFC Multi-Satellite Operations Control Center. The average telemetry data rate is 6.7 kbps.

INSTRUMENT DESCRIPTIONS AND SCIENCE LEADERS

Data Point Number 736: The Cosmic Ray Isotope Spectrometer instrument (CRIS) (Protoflight] (ACE) will provide measurements of the isotopes of galactic cosmic ray nuclei from helium to zinc over an energy range of about 100 to 500 MeV/nucleon. The fully assembled instrument consists of two boxes bolted together. One box contains the Scintillating Optical Fiber Trajectory (SOFT) system, while the other box contains the Si(Li) detector stacks with pulse-height analysis electronics and main CRIS control electronics. The SOFT hodoscope, which consists of three hodoscope planes and one trigger plane, measures particle trajectory. The fiber outputs are routed to two image intensifier/CCD assemblies. Thermal radiators are attached to the tops of the assemblies in flight to cool the image intensifiers and CCD arrays. The four identical stacks of large-area silicon solid-state detectors make multiple measurements of the energy loss of the nuclei as they slow down and stop in the detector stack. These measurements can be used to determine the charge, mass, and total kinetic energy of stopping nuclei. The high voltage power supplies for the image intensifiers are located to the upper left of the fiber plane. The readout electronics for each camera are in the black boxes. E. C. Stone (California Institute of Technology) is the instrument PI.

Data Point Number 737: The Electron, Proton & Alpha-Particle Monitor instrument (EPAM) (Protoflight] (ACE) consists of five apertures in two telescope assemblies and an associated instrument electronics box. The EPAM detectors consist of three silicon solid-state detector systems: 1) Low Energy Magnetic Spectrometers (LEMS); 2) Low Energy Foil Spectrometers (LEFS); and 3) Composition Aperture (CA). The LEMS/LEFS provide pulse-height-analyzed single-detector measurements with active anticoincidence. The CA provides elemental composition in an energy range similar to LEMS/LEFS, plus Helium isotope resolution. T. Krimingus (APL) is the instrument PI.

Data Point Number 739: The Solar Isotope Spectrometer instrument (SIS) (Protoflight] (ACE) is designed to provide high-resolution measurements of the isotopic composition of energetic nuclei from He to Zn (Z= 2 to 30) over the energy range from .10 to -100 MeV/ nucleon. During large solar events SIS measures the isotopic abundances of solar energetic particles to determine directly the composition of the solar corona and to study particle acceleration processes. During solar quiet times, SIS measures the isotopes of low-energy cosmic rays from the Galaxy, and of the anomalous cosmic ray components, which originates in the nearby interstellar medium. SIS has two telescopes instrument PI.

Data Point Number 740: The Ultra-Low Energy Isotope Spectrometer instrument (ULEIS) [Protoflight] (ACE) measures ion fluxes over the charge range from He through Ni from about 20 keV/nucleon to 10 MeV/nucleon. Exploratory measurements of ultra-heavy species (i.e., mass range above Ni) are performed in a more limited energy range near 0.5 MeV/nucleon. The ULEIS instrument is composed of three items: the time-of-flight (TOF) telescope, the analog electronics box, and the digital system box (or data processing unit). The telescope is mounted on the sunward side of the spacecraft and points at a 30-degree angle to the spacecraft spin axis. The analog electronics box is located nearby to minimize detector lead lengths, and the digital electronics box is located within 100 cm of the analog box. E. C. Stone (CIT) is the instrument PI.

INSTRUMENT DESCRIPTIONS AND SCIENCE LEADERS (Continued)

Data Point Number 741: The Solar Wind Electron, Proton & Alpha Monitor instrument (SWEP/AM) [protoflight] (ACE) is composed of the Los Alamos solar wind electron and ion analyzers from the Ulysses mission (BAM E and BAM I), with minor modifications. Each sensor is separately powered with its own low-voltage converter, fixed-level analyzer plate voltage supply, and channel electron multiplier (CEM) high-voltage supply. Each is operated with an independent microprocessor-based electronics control system, while both pass acquired data along to the central data processing unit. Both sensors make extensive use of curved-plate electrostatic analyzers (ESAs) which are spherical sections cut off in the form of a sector. D. McComas (LASL) is the instrument PI.

Data Point Number 742: The Solar Wind Ion Composition Spectrometer instrument (SWICS) [protoflight] (ACE) five basic sensor elements and operating principles are: 1) ions enter the SWICS through a large area, multi-slit collimator which determines particle entrance trajectories; 2) the electrostatic deflection analyzer allows only ions within a given energy-per-charge interval to enter the TOF vs. Energy system; 3) the ions are accelerated before entering the TOF vs. Energy system to give them sufficient energy to be measured adequately by the solid-state detectors; 4) the TOF system determines ion velocity by measuring particle travel time between Start and Stop detectors; and 5) the identification of particles is completed by measuring their residual energy in a low-noise solid state detector. G. Gloeckler (University of Maryland) is the instrument PI.

Data Point Number 743: The Solar Wind Ion Mass Spectrometer instrument (SWIMS) [protoflight] (ACE) consists of a versatile deflection system followed by a TOF spectrometer with excellent mass resolution. Solar wind ions enter the wide angle, three-chamber deflection system which acts as a UV trap and energy-per-charge passband filter. The deflection analyzer accepts incident ions over an angular range of +20° from the nominal direction and passes only those with a predetermined range of energy-per-charge (E/Q). Since ions with an E/Q outside the passband are blocked from entering the mass analyzer, protons can be excluded from the system by an appropriate setting of the deflection analyzer. G. Gloeckler (University of Maryland) is the instrument PI.

GROUND SYSTEM DESCRIPTION

APL is responsible or providing the integration an testing Ground Support Equipment system whose chief component is t e Integration and Test Operations Control Center (ITOCC). Spacecraft Operations are performed at GSFC in the ACE Mission Operations Center (MOC). Level-0 processing of payload data is performed in the MOC. The data are then transmitted to the ACE Science Center (ASC) at the California Institute of Technology. ASC is responsible for scientific processing of the data, making the data products available to the ACE Science Analysis Remote Sites (ASARS), and transmitting instrument commands to the ACE MOC for transmission to the onboard ACE Command and Data Handling (C&DH) Data Processing Unit (DPU). The commands are then transmitted to the desired instruments DPU.

CONTRACT AND SUBCONTRACT HISTORY

Contractor/Subcontractor	Project Element
N/A	N/A

LAUNCH AND MISSION ORBIT DATA

Launch Vehicle/Upper Stage	DELTA II 7920/None	Inclination (deg)	99
Launch Site	Eastern Test Range	Period (min)	103
		Perigee (km)	895
Mission Orbit Type	L1 Halo Orbit	Apogee (km)	896